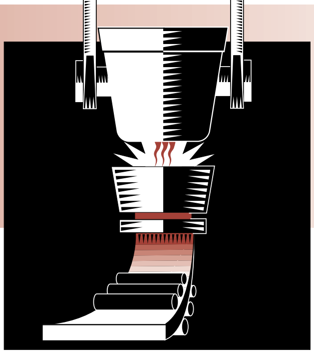
STEEL

Project Fact Sheet



Constitutive Behavior of High Strength Multiphase Sheet Steels Under High Strain Rate Deformation Conditions

Benefits

- Successful completion and implementation of the results from this project will guide the design and trial production of new high strength steels with unique high strain rate characteristics and minimum processing costs
- Improved use of input materials and resources
- The elevated strain rate data will lead to improved high deformation rate models resulting in improved capability to design vehicles and other structures

Applications

This program will define interrelationships between the ability to increase the strength of sheet steel through microstructure control and strength changes that depend on deformation rate. Through these relationships, inputs to computer models and guidelines to optimize material selection for crash-sensitive applications will be provided. The results, while primarily focused to the transportation industries such as the automotive industry, can be applied to other system designs which involve high deformation rates.

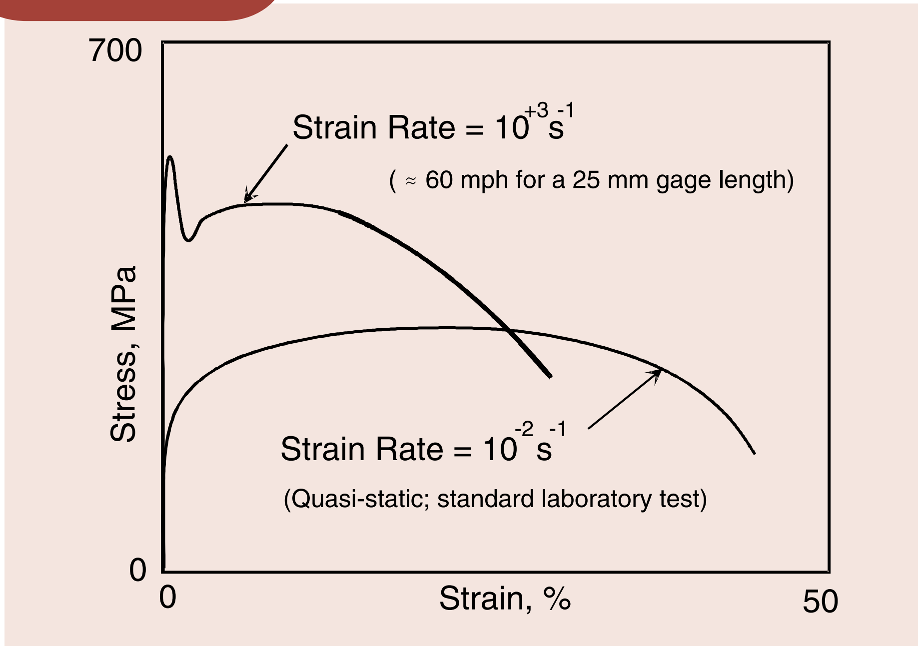
Increased knowledge of the high speed deformation behavior of multiphase sheet steels will result in lighter, safer, more energy efficient structures

The development of optimized multiphase steels with improved strength/formability combinations and high strain rate properties offers the potential for significant weight reduction in many applications, including automobiles. In addition, accurate characterization of properties at elevated strain rates will provide improved data on material constitutive relationships that will be used as input for improved high deformation rate modeling simulations.

This American Iron and Steel Institute (AISI) Technology Roadmap Program project addresses three basic hurdles: 1) Establishing the capability of testing sheet steel properties at elevated strain rates; 2) Understanding the microstructure and property interrelationships at high strain rates; and 3) Developing suitable chemistry and processing approaches.

This work will quantify the effectiveness of different metallurgical strengthening mechanisms at elevated strain rates. Furthermore, the global state-of-the-art in multiphase sheet metallurgy and vehicle application will be assessed, and a testing capability will be established for evaluation of high strain rate properties.

Low-Carbon Sheet Steel



Schematic representation of the effect of deformation rate on the tensile properties of a typical low-carbon automotive sheet steel. With a five order in magnitude increase in strain rate, an increase expected under crash conditions, the material strength increases and the shape of the deformation curve changes.

Project Description

Goals: To assess the global state-of-the-art in multiphase sheet steel metallurgy and applications, to establish a test capability for measuring mechanical properties at elevated strain rates, to quantify the effectiveness of different metallurgical strengthening mechanisms in the high strain rate regime, to design an alloying/processing approach for producing optimized multiphase sheet steel, and to provide data on constitutive material behavior.

Progress and Milestones

Project start date, December 1999.

Phase I: December 1999 to September 2000.

Met with sponsoring companies (December 1999), identified industrial participants of the project team;

Initiated survey; and

Developed a modified program plan which modified the originally pro posed Phase I, expanded the originally proposed Phase III, and deleted the originally proposed Phase IV.

Phase II: December 1999 to September 2000.

Acquire high strain rate testing system and establish testing procedures. Equipment was ordered January 2000 for anticipated delivery in August 2000.

Phase III: September 2000 to July 2004.

Based on the results of the literature review:

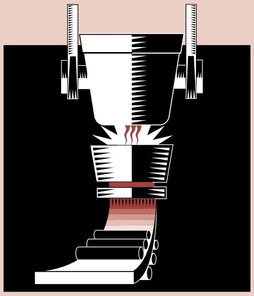
- Identify, acquire, and heat treat experimental materials;

Refine testing procedures for obtaining high strain rate tensile properties;

Evaluate mechanical properties and microstructures of experimental materials; and

Analyze and report results.

Project completion date, July 2004.



Project Partners

Colorado School of Mines, Advanced Steel Processing and Products Research Center
Golden, CO
(Principal Investigator)

American Iron and Steel Institute
Washington, DC
(Project Manager)

AK Steel Corporation
Middletown, OH

Bethlehem Steel Corporation
Bethlehem, PA

Ispat Inland Inc.
East Chicago, IN

LTV Steel Company
Cleveland, OH

National Steel Corporation
Mishawaka, IN

Rouge Steel Company
Dearborn, MI

United States Steel Corporation
Pittsburgh, PA

For additional information, please contact:

Isaac Chan
Office of Industrial Technologies
Phone: (202) 586-4981
Fax: (202) 586-3237
isaac.chan@ee.doe.gov
http://www.oit.doe.gov/steel

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov.
Visit our home page at www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

OIT

January 2002